Event-by-event jet quenching

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We investigate the role that realistic fluctuations and inhomogeneities of the fireball in nuclear collisions have on hard probes. State of the art calculations of jet quenching usually use parameterizations of an expected “average”, smooth fireball. However, we know that in reality fluctuations of the positions of the nucleons inside the nuclei and fluctuations of the nucleon-nucleon cross section can lead to very inhomogeneous fireballs.

In this study we used the recently developed jet quenching software package, reported on elsewhere here. We compare observables for single hadron suppression, di-hadron correlation functions and elliptic flow for two different scenarios. In the first scenario we propagate quarks and gluons through a smooth fireball, which is created by averaging over 500,000 events created by GLISSANDO, a simulation of initial nucleus-nucleus interactions using Glauber scattering [1]. In the second scenario we propagate the hard probes through individual Glissando events and then take an average over events afterwards, which is a better reflection of the situation in heavy-ion experiments. We use several different energy loss models for this study.

We find that comparison of data to calculations from smooth fireballs lead us to overestimate the average value of the transport coefficient qhat by as much 50%. In other words, if we take the point of view that we do not want to bias the results by choosing a particular size for the fluctuations, this introduces an additional 50% uncertainty on the extraction of qhat from data.

We find that after readjusting qhat we can easily fit the momentum and centrality dependence of single hadron suppression data from the Relativistic Heavy Ion Collider (RHIC). However, a residual deviation remains for both elliptic flow and hadron correlations, opening the possibility to distinguish different fluctuations strengths and therefore to conduct something close to a true spatial tomography of the fireball.

[1] W. Broniowski, M. Rybczynski, and P. Bozek, Comp. Phys. Comm. **180**, 69 (2009).